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RADIO EMISSION OF SATURN IN 8 MM WAVELENGTH

by

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SUMMARY

Radioastronomical investigations of Saturn in the 8 mm wave, conducted in July-August 1964, led to results, agreeing well in regard to brightness temperature with previous results of measurements of Saturn's infrared emission and corroborating the presence in 10 cm wave of increased radioemission which may be evidence of the presence around Saturn of a radiation belt.

* *

Radioastronomical observations of Saturn offer great interest. There is basis to assume that this planet is, analogously to Jupiter, a source of magnetic bremmstrahlung emission, which may be evidence of the presence at Saturn of radiation belt [1], and that the dust ring of Saturn hinders the formation of a radiation belt as intense as that of Jupiter [2].

The possibility of detecting Saturn's radio emission differing from the thermal emission of its surface or atmosphere is linked with the conducting of reliable measurements of planet's radioemission spectrum in the ultra high-frequency band. However, the remoteness of Saturn and its relatively low radiometric temperature hinder such measurements. Only radio emission of Saturn in the 3 and 10 cm wavelengths have to-date been the object of measurements with results published [1].

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* RADIOIZLUCHENIYE SATURNA NA VOLNE 8 MM.

Measurements of Saturn's brightness temperature have been conducted by us in July-August 1964 in the millimeter band using a PT-22 radiotelescope of the Institute of Physics in the name of Lebedev of the USSR Academy of Sciences (FIAN) with the help of a standard modulation radiometer in the 8 mm wave. To eliminate the measurement errors in the determination of antenna parameters, registration of Jupiter's radio emission were carried out simultaneously, and Jupiter's brightness temperature referred to the optically-visible disk according to [4] was taken equal to 144° K. Registration of both planets' passages along the azimuth at visual accompaniment by zenithal distance was made under conditions of optical visibility. Preliminarly according to Jupiter readings, the electrical axis of the radiotelescope coincided with the optical axis of the guide. When averaging the series of readings, weakening in the terrestrial atmosphere and the decrease in the output signal were taken into account (rather than the widening of the curve of passage), the latter due to radiometer time constant effect [5]. The calibration of antenna temperature and the control of constancy of amplification were carried out with the help of a gas-discharge noise generator.

The averaged readings of Saturn's passage were approximated by the method of least squares with the help of passage curves taken down in the same days by Jupiter, similarly as was done in the work [6].

Altogether 36 registrations of Saturn's passage, obtained on 22 July and 21 August 1964, were utilized for analysis. The result of averaging of 24 readings on 22 July and 12 readings on 21 August are plotted in Fig. 1. The mean arithmetic values of brightness temperature, referred to Saturn's disk (without the ring), constituted respectively 129 and 144° K. The root-mean-square random errors of these values constituted respectively 10 and 20°. The weighted average (taking into account the random errors) of the brightness temperature of Saturn in the 8 mm wave constituted $T_{br} = 132^\circ \pm 9^\circ$ K, where the error represents the root-mean-square error of the weighted value.

The brightness temperature, obtained by us in the 8 mm wave, agrees well with the results of measurements of Saturn's infrared emission [7, 8], according to which its brightness temperature is 125° K*.

* According to measurements in the 10 region [10], the brightness temperature of Saturn would constitute $85 \pm 2^\circ$ K.

Comparison with the results of measurements by Drake in the 10 cm wavelength [1], who obtained $T_{br} = 196 \pm 44^{\circ}$ K, and also with the results

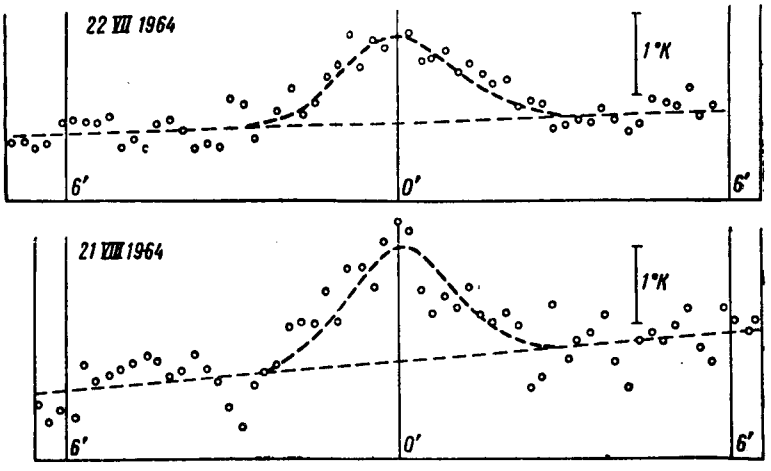

Fig. 1 Results of averaging 24 readings of Saturn passage on 22 July 1964 and 12 readings for 21 August 1964. The angular distance in the pictorial plane is plotted in the abscissa, and the antenna temperature — in ordinates. The dashed line shows the approximated values.

by Rose, Bologna and Sloanaker [9], corroborates the presence of increased radio emission in the 10 cm wave, which may be evidence of the presence of a radiation belt of Saturn, though this increase is substantially less than for Jupiter. As to the brightness temperature, in the 3.45 cm wave, of which there is question in [3] ($106 \pm 21^{\circ}$ K), this value does not contradict that obtained by us. Obviously, in order to ascertain the nature of Saturn's radio emission, a great significance could be contributed by measurements of brightness distribution and of the degree of polarization of radio emission.

*** THE END ***

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REFERENCES

[1] F.D.DRAKE.- Nature, 195, 893, 1962.
[2] F.D.DRAKE, H.HVATUM. Astr.J. 64, 329, 1959.
[3]. J.J.COOK, L.G. CROSS et al. Nature 188, 393,1960.
[4]. D.D. THORNTON, W.J. WELSH. Icarus, 2 No. 3, 228, 1963.
[5]. A.D. KUZ'MIN, A.E.SALOMONOVICH.- Radioatsronomicheskiye metody izmereniya parametrov antenny (Radiometric methods of measurements of antenna parameters)., 1964. [no better ref.available]
[6]. A.E. BASHARINOV, Yu. N. VETUKHOVSKAYA et AL Astron.Zh. 41, 4, 707, 1964.
[7]. D. H. MENZEL, W. W. COBLENTZ.C.O.LAMPLAND, Astrophys. J. 63, 177, 1926.
[8].- E. PETTIT.- Sb. Planety i Sputniki, IL, 1963.
[9].- W. K. ROSE, J. M. BOLOGNA, R. M. SLOANAKER. Phys.Rev. Lett. 10, 123, 1963.
[10].- F. G. LOW., Astronom. J. 69, 143, 1964.